
फफूँदी और बेधकों (पाउडर पोस्ट बीटल) से
लकड़ी की सुरक्षा के प्रयोगशाला
परीक्षण की पद्धतियाँ

भाग 2 बेधकों (पाउडर पोस्ट बीटल) से लकड़ी और
बाँस की सुरक्षा के थ्रेशोल्ड मान ज्ञात करना
(तीसरा पुनरीक्षण)

**Methods of Laboratory Testing of
Wood Preservatives against Fungi
and Borers (Powder Post Beetles)**

**Part 2 Determination of Threshold Values of Wood
Preservatives against Borers (Powder Post Beetles)
in Wood and Bamboo**

(Third Revision)

ICS 71.100.50

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FOREWORD

This Indian Standard (Part 2) (Third Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Timber and Timber Stores Sectional Committee had been approved by the Civil Engineering Division Council.

This standard was first published in 1968 and covered the methods for the laboratory testing of wood preservatives against fungi. Details of preservatives, methods of preservative treatment of timber, etc, have been covered in IS 401 : 2001 'Preservation of timber — Code of practice (*fourth revision*)'. Based on the experience gained in the use of the standard, the first and second revision of the standard were brought out in 1993 and 2008, respectively.

In 2008 revision, this standard was bifurcated into two parts. This Standard (Part 2) covers determination of threshold values of wood preservatives against borers (powder post beetles). The other part of the standard is:

Part 1 Determination of threshold values of wood preservatives against fungi

In this revision, the following major modifications have been incorporated:

- a) Scope of the standard has been extended to cover testing of bamboo in accordance with the standard, and the title of the standard has been accordingly modified.
- b) Principle of the test has been given in more elaborate manner.
- c) Preparation of test samples for adult release method has been updated with the inclusion of bamboo specimens.
- d) Pattern of holes on test block in larval inoculation method has been explained.
- e) Three additional methods, that is spraying method, dipping method and pressure impregnation method have been introduced in the clause on treatment procedure.
- f) Type of test insect has been introduced for bamboo.
- g) New clause on exposure of test specimens to the insects has been added.

The composition of the Committee responsible for the formulation of this standard is given in Annex E.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done accordance with IS 2 : 1960 'Rules for rounding off numerical values' (*revised*).

Indian Standard

METHODS OF LABORATORY TESTING OF WOOD PRESERVATIVES AGAINST FUNGI AND BORERS (POWDER POST BEETLES)

PART 2 DETERMINATION OF THRESHOLD VALUES OF WOOD PRESERVATIVES AGAINST BORERS (POWDER POST BEETLES) IN WOOD AND BAMBOO

*(Third Revision)***1 SCOPE**

This standard (Part 2) lays down the method for the laboratory testing of wood preservatives against borers (powder post beetles) by exposing the wood/bamboo samples to both adult and larvae of test insects or keeping them along with material infested with powder post beetles in the laboratory. The test can also be employed to determine the natural durability of different species of wood/bamboo.

2 METHOD OF TEST

The method determines the toxicity of the surface applied with wood preservatives to the powder post beetles (*Lyctus africanus*/L. *brunneus*/*Sinoxylon anale*/*Minthea rugicollis* for wood and *Dinoderus minutus* for bamboo).

The method is applicable to the tar-oil, water-borne and organic solvent types of wood preservatives. It enables comparisons to be made between preservatives which belong to any one of the types, since it is not possible to ensure that one test will accurately take into account the different mechanisms by which various preservatives operate under service condition.

3 PRINCIPLE

3.1 The principle of this test is to determine whether attack takes place, and adults subsequently emerge from samples of susceptible wood or bamboo which have been treated with preservatives and exposed to the test insect for egg laying. Control test with wood/bamboo blocks of similar types which have not been treated and those treated with the solvent only and exposed to test insects, adults or larvae, shall help in knowing the natural durability and also to compare with treated wood/bamboo for their efficacy to protect from beetle attack. The susceptibility of the wood/bamboo and efficacy of preservative is tested by releasing adults on to the test specimens and inoculating the larvae into the test blocks. In case of adult release experiment, four

pairs of freshly emerged adult beetles are transferred to test blocks and the test gets concluded once 100 percent mortality of the introduced adult beetles is observed. The larval transfer method involves the transfer of healthy larvae into the holes made on the test specimens and the test period gets concluded after 70 percent of the larvae inoculated into the control test specimens have successfully emerged as adult beetles.

3.2 Preparation of Test Samples**3.2.1 Test Specimens for Adult Release Method**

The test samples shall be made from the timber of semul or rubber or mango and shall be of sizes 100 mm × 40 mm × 12.5 mm. The test samples will have the long axis parallel to the grain of the wood and the wide face tangential to the growth rings. In case of bamboo, the specimens shall be 50 mm long cross-sections of test bamboo. These test samples shall then be open-piled and thoroughly dried in a well-ventilated room. These shall not be dried in a kiln or otherwise heated. Wood blocks which are clean, bright, free from knots and are of heartwood showing no abnormalities in structure or rate of growth and in bamboo free from any insect attack or sap stain shall be used. Each test sample shall be tested for starch content and those in which it is inadequate, shall be rejected (*see* Annex A).

3.2.2 Test Specimens for Larval Transfer Method

Specimens of size as specified in **3.2.1** with ten holes of 2 to 3 mm diameter and 3 to 4 mm depth shall be drilled on wider side of each block in fixed pattern using a template. All holes drilled are smoothed with a round file to avoid damage to the larvae during inoculation (*see* Annex B).

3.2.3 Before being treated in the preservative, the test samples shall be conditioned for two weeks at 25 °C to 30 °C and 70 to 75 percent relative humidity to attain an equilibrium moisture content of approximately 15 percent. The end grain of the blocks shall be sealed with paraffin wax or other suitable sealant before

treatment, in order to prevent undue penetration of the preservative through the ends.

Untreated control blocks shall be selected and end-coated in a similar manner. The total number of samples required for each test shall be as follows:

- a) At least 6 numbers shall be treated in preservative, at each concentrations and method used;
- b) At least 6 numbers shall be treated with solvent only; and
- c) At least 6 numbers shall be untreated control samples.

3.3 Treatment Procedure

A series of dilutions of the preservative shall be prepared on a weight/weight basis. A minimum of six concentrations, arranged about the expected toxic limit, shall be used. In the case of a new preparation of which the approximate toxic limit is unknown, the concentration should be in a widely spaced geometric series in the first test and a more closely graded arithmetic series in subsequent tests.

Three methods of treatment as follows may be carried out for the study and six test specimens shall be used for each method as follows:

- a) *Spraying method* — The treatment solution shall be sprayed over the test specimens uniformly.
- b) *Dipping method* — The test specimens shall be dipped in the treatment solution for 24 h.
- c) *Pressure impregnation* — The test specimen shall be treated with treatment solution for 15 min of vacuum and 60 min of 3.5 kgf/cm² pressure.

If the preservative is soluble in water, freshly prepared aqueous solutions will be used. Preservatives that are insoluble in water shall be dissolved in a volatile liquid such as benzene or other suitable solvents which has been shown not to leave a residue toxic to the test insects.

The test samples shall be weighed and then completely immersed in the solution for 24 h in dipping method, treatment with the most dilute solution being carried out first. A series of six control test samples shall be treated in a similar way in the solvent employed for dilution of the preservative.

If the preservative is in the form of an oil-in-water emulsion, the control test pieces shall be treated in an oil-in-water emulsion which has the same composition as the preservative, except that the toxic ingredients are omitted.

It is essential to follow the same procedure in detail in all tests as slight variation may influence greatly the amount of preservative retained.

On removal from the treating fluid the surplus liquid shall be quickly shaken off the paraffin-coated ends blotted on absorbent paper and the blocks immediately

reweighed. The amount of preservative taken up by the blocks shall be calculated from the rate of the liquid absorbed (weight after treatment minus the initial weight) and the concentration of the solution. The concentration of the preservative shall be expressed as kilogrammes per cubic metre of exposed wooden block. Six blocks per concentration shall be selected in which the weight of solution absorbed does not vary by more than 15 percent from the average absorption of the batch. The test samples shall then be dried, by passing air at a temperature of not higher than 30 °C over them, till all the control test samples treated in the solvent only, have returned approximately to their initial weight.

All the test samples (including the six untreated control samples) shall then be stacked in open at room temperature for at least a month.

3.4 Test Insects

Adults of the powder post beetles, *Lyctus africanus*/L. *brunneus*/Sinoxylon anale/Minthia rugicollis for wood and *Dinoderus minutus* for bamboo, shall be used for the tests (see Annex C) and these shall be obtained from laboratory cultures maintained in the manner described in Annex D.

For initiation of culture, beetles are obtained from naturally infested wood stored outside, which have to be brought and maintained in the laboratory. Untreated timber such as semul/mango/rubber/bahera/dry tapiocca chips or bamboo, which serve as feeder with starch, shall be kept along with the infested sample for continuous multiplication of the beetles.

3.5 Exposure of Test Specimens to the Insect

3.5.1 Adult Release Method

Four pairs of healthy and freshly emerged adults (male and female) of *Lyctus africanus*/L. *brunneus*/Sinoxylon anale/Dinoderus minutus beetles shall be introduced into each test specimen (treated and untreated, without holes) placed in an aerated box maintained at a temperature of 25 ± 1 °C and at 75 ± 1 percent RH in B.O.D incubator. Observations on the longevity of the adults and powder formation in test blocks shall be made along with that of controls daily till the adults are dead and once in a week till the next generation emerges.

3.5.2 Larval Transfer Method

The test blocks with holes shall be stored singly in aerated containers. Six blocks per each concentration, six untreated control blocks and six treated with the solvent alone shall be exposed to same instar larvae of the test beetle. In each hole one healthy laboratory bred larva of the test beetle, free of mite infestation shall be inserted. Ten healthy larvae are introduced into each test specimen containing ten holes. Periodic observations

shall be made to study the activity of the inserted larvae in the treated and control test specimens. The activity of the larvae shall be indicated by the presence of powder like dust thrown out and heaped above the holes (*see* Annex B).

3.6 Examination of Test Sample

The samples shall be stored until emergence of the first generation of adults from untreated control is in progress (6-8 months). After this has occurred, all the blocks shall be examined. Sample with no exit holes shall be finally split with an axe to ascertain whether live or dead larvae or tunnels are present. Final weight of the test samples shall be taken and the percent weight loss due to larva eating the test samples shall be calculated and reported in the results.

3.7 Evaluation and Reporting of Results

The number of samples, treated and untreated, which contain exit holes shall be recorded, as well as the number of treated sample without exit holes in which live larvae are found.

The threshold value (toxic limit) shall be expressed as the interval between the highest concentration at which the adult beetles emerged or live larvae are found at the end of test and the concentration next highest in the series in which no adults emerge and all larvae are dead. These concentrations shall be expressed as kilogram per cubic metre of wood.

The concentration of treating solution found necessary to give these figures shall also be stated, as well as the diluents used and the interval between impregnation of treated samples and exposure to the infestation.

ANNEX A

(Clause 3.2.1)

METHOD OF TESTING FOR STARCH CONTENT

A-1 For the successful development of *Lyctus africanus*/ *Sinoxylon anale*/ *Minthea rugicollis*/ *Dinoderus minutus* larvae it is necessary that adequate quantity of starch be present in the wood. This can be assessed by a visual test as given below.

A-1.1 Reagent

A-1.1.1 Iodine Solution (0.5 percent) — Add 0.5 g of iodine to a solution of 1 g of potassium iodide crystals in 5 ml of water and dilute this solution to 100 ml water.

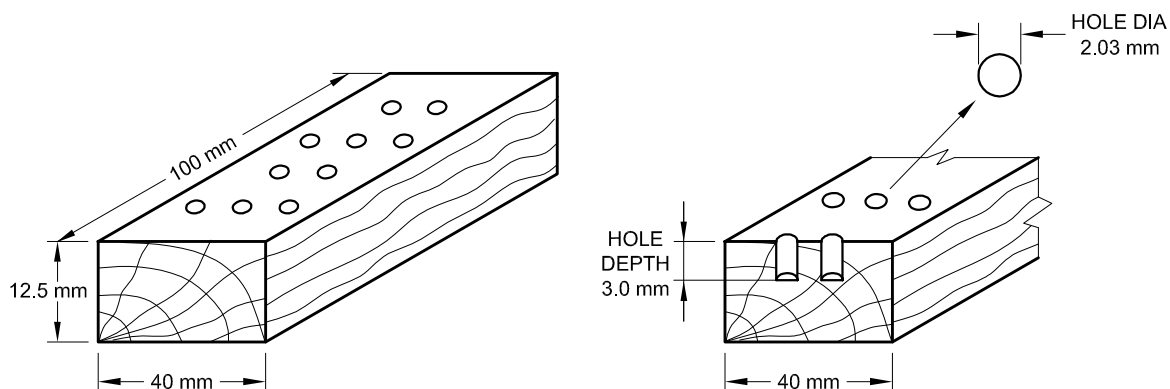
A- 1.2 Procedure

It should be ensured that the surface of the wood to be tested is smooth and clean. The solution shall be applied with a small paint-brush, preferably to an approximate radial surface, that is the narrow side of the block. After the lapse of a minute or so, starch grains which are stained blue-black, will be clearly visible under a binocular microscope. Only blocks containing abundant starch grains indicated by development of blue colour, are suitable for use.

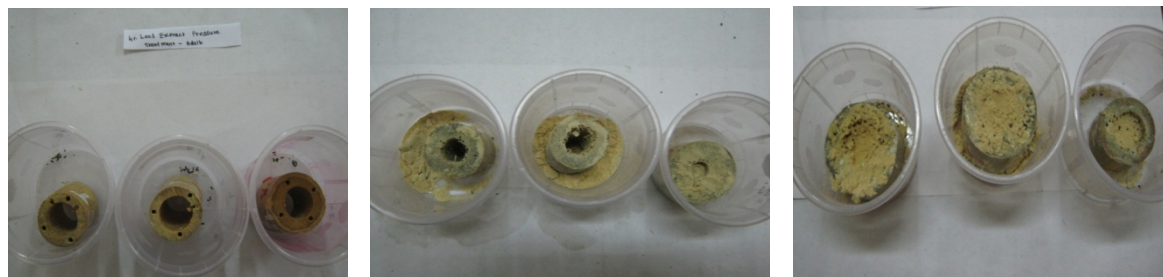
ANNEX B

(Clauses 3.2.2 and 3.5.2)

LARVAL INOCULATION METHOD — TYPICAL PATTERN OF HOLES ON TEST BLOCK AND LARVAL ACTIVITY



Lyctus africanus Activity in Bamboo Specimens



Dinoderus Activity in Bamboo Specimens

ANNEX C

(Clause 3.4.1)

BIOLOGY OF THE POWDERPOST BEETLE *Lyctus africanus*

C-1 Different species of powder post beetles display minor differences in appearance, habits and longevity. *Lyctus africanus* has a distinct head and the terminal segments on their antennae have a clubbed appearance. The larvae are cream coloured with brownish head and jaws and three pairs of small jointed legs; on hatching, they are about 0.3 mm long and C-shaped.

C-1.1 The female adult of *Lyctus africanus*, after mating, seeks a suitable place for egg laying and bites the wood transversely, leaving a series of grooves (tasting marks) on the surface. The tasting marks may serve to determine whether the timber contains starch, the essential larval dietary requirement and they also expose wood pores for subsequent egg laying. Using her ovipositor the female lays into the open pores of the sapwood. Each female may lay a total of 70 eggs, with a usual limit of three eggs in any pore. The number of eggs laid is positively related to the number of tasting marks. Eggs are deposited at depths of 1.0 to 6.5 mm in the wood pores, preferentially from a transverse surface, but also through radial and tangential faces.

C-1.2 Egg hatch after about 14 days and larvae feed on the starch in the sapwood until fully grown. Tunnels

usually follow the grain of the wood and only the larval stage destroys the timber. The development period for larvae varies from 2 to 18 months depending on temperature, humidity and the supply of starch in the sapwood. Under adverse conditions the life cycle may take from 30-48 months or even longer. Fully grown larvae tunnel towards the wood surface and excavate small oval cells where pupation takes place. Two to three weeks later, mature beetles begin to emerge through the surface of infested timber, making a round hole (0.5 to 1 mm diameter) as each emerges. Small piles of frass associated with the emergence holes may collect on the surface of infested timber or fall nearby. Emerging adults push a small amount of frass out, but larvae living within the sapwood also cause frass to continue to fall from emergence holes and from cracks in the timber. Adult lyctines are sexually mature upon emergence. Copulation occurs soon afterwards, often crepuscularly or nocturnally rather than diurnally. Egg laying begins soon thereafter. Emergence holes expose pores into which eggs can be laid. Re-infestation of timber is common and may continue until the food resource is completely used up usually within 4-5 years of felling.

ANNEX D

(Clause 3.4.1)

METHOD OF CULTURING POWDER POST BEETLES

D-1 TEST ON WOOD SPECIES

D-1.1 Culture of *Lyctus africanus*

Culture of *Lyctus africanus* from egg to adult occupies 1 or 2 years under outdoor conditions in this country, the beetles emerge from June to August. This period may be reduced to 9 to 12 weeks at 25 °C and 75 percent RH and a continuous supply of beetles thus can be obtained. Tapioca is converted into chips of 2 mm thickness, air dried and stored in glass bottles. For initiation of cultures, beetles are obtained from naturally infested sapwood stored in outdoor insectaries, either by collection from the surface of the wood or by means of a light trap. The naturally infested wood should be removed to outdoor conditions as soon as beetles have been obtained and the beetles should be introduced to clean glass bottles half filled with dried tapioca chips. Emergence begins 65 to 75 days after the original beetles were added, reaches a maximum after 88 days and ends after approximately 120 days. Each jar may yield 500 to 700 beetles and by setting up 1 jar per week, a weekly yield of 500 to 600 beetles can be obtained from 9 jars containing insects at different stages of development.

D-1.2 When initiating new culture, beetles obtained from a number of vessels are randomized and from these 25 pairs are used. To avoid harmful effects of prolonged in-breeding it is advisable to initiate a new series of cultures annually with beetles obtained from

infested wood stored in outdoor insectaries. There is no information on the comparative fertility or susceptibility to toxic substances of beetles collected from outdoor stocks or cultures. Precautions against mite infestation are necessary.

D-2 RECOMMENDED PRECAUTIONS AGAINST MITE INFESTATIONS

D-2.1 A two percent solution of beta-naphthol in 97 percent ethanol is effective against mite. The glass containers and cambric covers used in the test should be dipped in this solution and the solvent allowed to evaporate completely before the introduction of beetles, since ethanol fumes are toxic to beetles.

D-3 TEST ON BAMBOO SPECIES

D-3.1 Culture of *Dinoderus minutus*

The different species of bamboos collected from plantations/bamboo depots can be cut into small pieces (50 mm to 300 mm) dried to 20-30 percent moisture content and provided to adult *Dinoderus minutus* released into mesh boxes/glass bottles/cages. Also tapioca chips cut into 5 mm thickness and dried in sun shade can be used for rearing the beetles. *Dinoderus minutus* can be released on the dried chips kept inside culture bottles. The culture can be maintained at laboratory conditions to get sufficient stages of the insect pest for experiments

ANNEX E*(Foreword)***COMMITTEE COMPOSITION**

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